### Ingaging students in the classroom



**Eric Mazur Physics** 

12 October 1999 Tech & Ed Planning Meeting



### Technology is not a magic bullet

## brief history of Information Technology

- blackboard
- overhead projector
- television
- computer



What's wrong with old methods for presenting content?

לפורכות נפעותכנה בלונטופות לפיור עלוון חווכו pure ware not whenly purer will in לביל כותיים כי לחויים ויכורים בא שונה חי The course then police primer forever לוך צוביל לחסור לכב בדילום חידור קופן כמו חבריחון ו כפבוצות בי עולון חוצה

מו דוב חניארום על כול בעניאור ויאוקר נכא אין אי כלן אין כנווא כלישויוב עונויואי ובנו כ בבריכון כובוו ברוב עריות ביקטורית . ניחוו יניי לאוף ממנחי ינייריותי ניוכיע קולהוכיוה ולרונה על מוכלקה פיוניע נישליון ועל שונותנה וחויין שרחותר בושרות שליות שיניותונה להואי דלה דוויים כרישנים יוכות וכבר אדוף לריעת שיוני ב ב ב של במכור למוכל בעל בכירום בן the same of the property

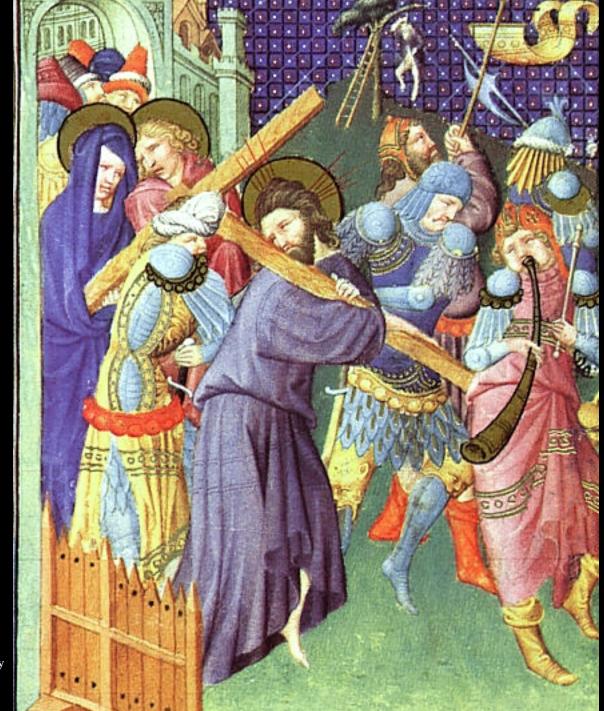
וברוףי שבי לעולף ועף כלבותכה כלחו כול עולבות ובכשולונה ברון ויווי בייוי ב בי בי ביניים עובר לביולף ועוד ביינים יולרוחוף כריביוו וחפור פכול בעשור מיוף בב ב ופיוף שבריעולף ועדי שוכני בו אים אוונילותף ווויני לפול מכטונות מיוף בצוף בומיוף שפי לינוולתיוני עונו בת יתינה ושברוניות נתן להכת ייובלכה בעתו בירורי ב ב בפרוף שכן לעולם וינף בחנו יותר און הדינות הכישורים לפול חוריינות פרוף עם בי יבירוף ישמי לעולףועף ינףיים בב בבול מינור יווסוף פניול פעשוו פיוף הגף גופיוף שכו לעולף ועף קייונים בגב דנייוף עופדינעיים וייניי דיקריאותר בייניות בייודיים ומידים עובר לעולף ועד ריעון ודיאור ועשוף דיאור שוניחור וושלעו דווישויען בייווי בשב בייווים וכן לענילף וען HARM HERE A MANNEY HERE & HOURS HOURS The open as green agaington

quipped a something the agrating

לעודים חווים חוויל בו בו בו בו בו בו לעולים חווים של וויאועות בייות עורי קומי שווי בע בב או או או או או או או א ב פרובנו יכון אב ב בעומתו גבורו כווני ליכוות ביו בי במכוח באים מוב לחטות בב בי לינונב שייבות טוב לכווכ פגאון א כפנוח כשלף ינם אדיו לו ב ב מובני לעולף חטויו הולוח

תכלון לאורץ אוופנבון ב בי אוווי ווכיף האברבת שמה לעולף ועף פרוף הבדה ומיוף שפן לעותף ועף ברוף יונף אברכנה ואהללה שכנה לעודי ועף איינים ליולי בין אינון יונין שיון שליונים וויין בין אינון אינון אינון יונין אינון יונין אינון אי אין דייני מין דייני מין איני בין דייני איניילערילייים יירילייר שפחו כעשונה ועבורתוכה ישוף מייף בשב ינברוך שכן לעולף ועף חריף בנוך חווכה חיבתי ביאותובה THE THE PARTY OF T 





Belles Heures du Duc de Berry 1408-09 The Way to Calvary fubleautur. Himiliterer facta bona manifesta sunt : er que aline se habent abscondi non possini II.

micig für fub ingo femi dioa fuoe orm brore dignos arbitentine nome oni abodeina blatplemeter. Dui aut fideles habent divos eigem del: vil evil ein temmatique fit : fed magie fenciat ga ficeles fur a diledi : ga benefini participe funt het bare: refpicare. Bi qu alim dom-rud amuielat famis fenuonibs diti urithelu milti- et ei que hom pierare e bodine: lupabus nichil farme fed langues area quelliones a puguas urboutes quibs oriutur înuidie atentiome blasphemie sulpiciones male-offidaciones fominu mam cormptorii a quattan prinan luccentimatiu questa elle piccare. Lett aut quelt magme: pietas aum luk-Accenta. Michil ent intulim9 in hunc mudu: haur dubiu ga nec aufeur fo millum? Materes aut alimita et fibus teganichijo ominitum?. Mā quolunt Truites for incibile i contantino a fla

diamici folus babet immortalitatem aluctinhabitat inaccellibile:que nully hommuldit led nec vitere potelt: mi honor i impritti fempietani amen. Duindes haid fectali pape no lublime fauxemen speare in incaro dinitiari led i do wino à pillar nobie aia abide ad kurdu: time agare: dinites fieri i bonie opribafacde cobuere-omunicare: સ્ટ્રિવાલંક્રમ્પ પિર્ણ કેવેઇ નામલાની bond in ficeneut apphender wram vira. Withis mother depolità cultodi denicae minnas voci nomiares et appolinants falli noto tattie: qua quită prainte arra fibem griberur. Brana tecu amê. Expluit emista prima abehimomen Juant evgrunttu meplam kamda muchimotheo farbit de eghoztacone, marting a mile regule veritation and futur fit moribs noudlinis-4 de fira pallione: louis a roma. Oculust argu menti Junia enla cola ad themo Auha appllol Hitti

itelu milti p volüna

men milatine maniste

fubleautur. Himiliterer facta bona manifesta sunt : et que aline se habeut abkondi non pollimi W. uicung liit fub iugo ferui dinoa

#### proho

popurpomia nepi riprilgri Arique milito-mopri fiprolominimo milituro alternio mi obelio ali 18 ficilia miuros pompe apuro bilinguese been northerford less gar minus and functions by his garging depth of the fact of manine uncoun que notagentant es apollotori es-Aurites promaligent. En quits ref-te be unte reference freguesa que é Tetulat n police robiobus non babrener; et of all the group of the state of finî parc mental naturinos socialmente si between in your objectives. Survival for petite rive Survivages pion in for net pelice with not every author's an in our biscoines attender que propera-Bì na per halipronting in: a marke sike ther propose forcepose believes at . Boss. regresse ergo no ste ber feronalis: mis ferru betrairis professe" (Primi) ethion-più et imple-inipum in risio-erasi and its above disjoint in it due to the control of que lidin montes their farther quiets pla tonie bojme autor utokać fomie strane lazeni alide kryma utokać bryšte bla u tpicrelida aur alier kryšte bla u tpicrelida aur alier kryšte bla u tpicrelida aur alier kryšte bli aur enlieta secreji; se e cys lanikanać; u antami bar no F PINE tut inuil udgame. Erneleb quie pul autor Spausging others almanber om luicionn band for general quite trad ned forgeneral et anthus malet pole-me speripeles i si sela più store intiphio antel sals prainses: lib is-

lucreritti

une beliffen megespace ependiffe ferbir nim gebreefe, Princh i est elle narme: ellegt i elle templel. Els faitet onovice Staling bis mutaling in wethers ripia is que inertifije manifer. Hich berr pendane et milien prominent prominent syluminis pringer in te-milimis printinents etilans trija-na ljeda mithaldi. Ana aber br-nibusa ibne pri djavapis in medina-den y apolicios brows landus mfine point repoir ; or op the exception but Imaged offer services fine . Every spinor : Demokra atomi (Blasion int golf prises intotam benet bis more pri-lemas laborara", (Ili stergion lic int atomis giar of referris bulya acted in kindig ass our extracts em lecture", Plient toron autora : als-H ofe narrows, fill out? seeling you set? a profess?. Rubispear took: observer colonia. For be plans. Per illen de ende gion finan-quide des galante sons berteufes serviness galante layer quite abbest plan papel sonspies molt. Desti baser respient (Deb igenes also sea me seuse : Brinds militation etc.as trovinam inimpiga bilerine : beldani sefesi sefene ciliate (Cd dia babbi be appie improvi critica. Del di batchi in-gio nu colore mi batchi. Piccia i S-cianti i publica sil apia silempera ulti-monisti publica si i monistimine i ferra replatara i tenice di prica: grant di tra-bulta. Aj in far sen intito. Pilar e ingli-ta i ilidei colore mi piene sidi api ilizzabili i alginali sposiai supra sodi-tica benti i pulli mi ili dei pro lampi lari birci i tenni spa sullera franzanti.

difamificial habet immortalitatem aluctinhabitat inaccellibile: que mully hommundit fed necuntre potelt: acibonor 4 imperia fempicana amaa.

Eprinciple entact that and fire sidder environs. Er mibie is' er-eller broke n laté futgern mane ben quart. Disc man bles . Probater oper er commun. Derne deuters man begende er national's rearber extent flag faced attacks or figuress bell forefamor flagor sequess, Descrip toron flagor for faced flagor for author bears foreign flagoring, or much mine warmen module bog arrive : leb bossemby oil , Contrary brus eer grandia er orené animal w centeria ang montanana que principa-ciant espera incon linea, e seme un tante franchis princi fici, de sobre be-us ay elle borne: beneficia en monta, Enfere e multiplication en replies a-quale manta i autifiq molaphimente laper metros. De ladici polyte y comer laper metros. De ladici polyte y comer luma bires materiores maders. Fuell to off partiers a manual place arrows. Doors group bear, flor tomerand in mebig asycard: er blotbet aguns ab aques. D front brus fernament : bisslarge expense aper extended the free desired and the first pair makes from the accommission of the first free desired them. tips quines. Even good brown (For-burst titte animal pursuess in grower School Secres land, field field fr. Ar fick brow britan one yang Secres So mman ties incobes. Desture tous. Congrepence aque que lisb eta face la laçaca pelà es agracam delpa. der instanten i dentur ripade som in de-Er linbere ift ice. Er unchger bres an ner lag. Er poix bres quilin bour er ont. Parison I present at recognic to Monte in maltis a plan printer mono-a opinistic etc a latina qualific mon ht book - e air. Econige was berbiorien should be report i seen. It con-sis bree bosses at readying a feetaccepted the bearing a few start of figure 2 tall : cotes from in knomde for laper presen . Er linkenzelt un . Er gronde leutiol faite: at reaspiere it ma-ur filirations of feates retain us. Fractions die bree - e. at. Lefar is techniquesens i spier mass - e. Lact hat it was tree prife tank or fash it often tree prife tank or fash it often it was try union. Disemble of a straight in a in forwarde of a straight time at notice for in figure a spece a bits o antiminipus que sequenter luy arci Dieny brus, fire tries unbes quesd between officeness from lay recom-er cooles ligna que labit i française Caspink werf. & fact i et un freien oti i amiurifea il aspailiur in arca mi queltra il aminia sioria: se il pitale ata solimitti. Il tanti eli na. Vigilioji tran matus or feller but it busines said ut jeffer noders Bellara s pelvir ses in Bernarosko eki ur kunntur Gup sesie st

કાતો જો દુઃક inilione:foite a roma. Oculuit aran

> Aulus amttol Histi ikin niti p volüra our willown muille

oiaabūk

a fimî i bo:

nunitare:

betatone

ation front

Adentia. Michid en moulem9 in hunc

müdü: haur dubiü ga nec aufeur ga willum9. Materes aut alimeta et fibus ienanichiioomialim9. Mā quolunt dinites for incidile lefteranno a fla

fubleautur. Himiliterer fada bona manifesta sunccer que aline se habent abscondi non postinu III.

micigs für fub ingo ferni dinoa finoa onin briore dignos arbi-

nuomunat leuciat na fi fini parnap Bi na mis ferruon que lidini pi nidril Tame ance a bird tur innidie luicionts n lücceittimä

right beight in Gegen werdern mittle in seen beiegen Ernel gemein der Ausgeber der Ausgeber der Ausgeber der Aufgeber der Beight der Schaffe gemein der Ausgeber der Aufgeber der Beight der Schaffe gemein der Ausgeber der Aufgeber der Beight gemein der Aufgeber der

aut quell maguns: pieras aun lukkaeuna. Michil eni inndimi in hunc

műdű:haur dubiű ga nec aufeur ga

ieganichijostatulim<sup>9</sup>. Mā duolunt

Cum9. Chateres aux alimera er õtul

Completency in the formation in the property of the complete in product probably comme from the in minimum probably comme from the in minimum probably in the comme management part of the comme to the complete in the comple

diaminifolus babet immoralitatem rlucimbabitat inaccelibile: que mully homourimpera femperaturama, diabitat pape no fublicat Dinitat può feculi pape no fublicara

makes delectrifications on the control of the contr

telen between mer einem ernete ein er

is of a about ites firm i boomunicare:
noi bomi in
n vitā. W thicoitās, phappolinones
idā pmināri
ma troi amē.
abehinosiri

futus fit morils noullimis-4 de fira jailionerfoide a roma. Scrittic argumentil Incust enla loda sit dremit

> Aulus apollol Aixi itelii villi p voiiis



DISCORSI

E

### DIMOSTRAZIONI

MATEMATICHE,

intorno à due nuoue scienze

Attenenti alla

MECANICA & I MOVIMENTI LOCALI,

del Signor

GALILEO GALILEI LINCEO,

Filosofo e Matematico primario del Serenissimo Grand Duca di Toscana.

Con una Appendice del centro di granità d'alcuni Solidi.



IN LEIDA,
Appresso gli Essevirii. M. D. C. XXXVIII.





# not delivery of information but assimilation of knowledge



think about educational goals before introducing technology

### What constitutes effective use of technology?

- furthers educational goals
- facilitates new modes of learning
- investment commensurate with returns
- reusable and flexible

### What problems can technology help with?

#### Large lectures...

- are impersonal
- focus on information transfer
- don't necessarily address students' needs

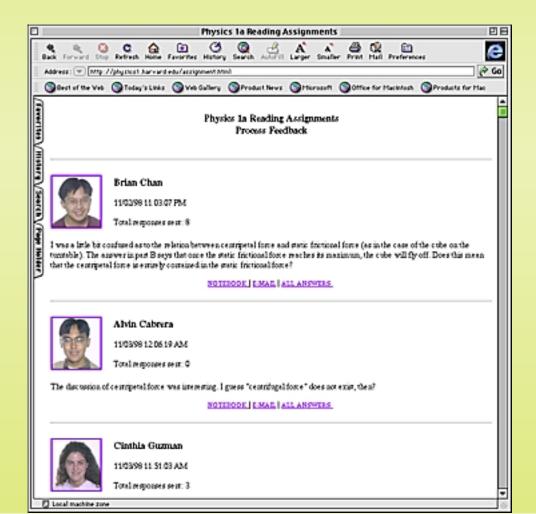
move some of the information transfer Shelt of the Vec. Of Colly ELivie O'Vec Gallery. O'Product Neves. Of the roads. O'Office for the Otto O'D. find out what needs to be "lectured" on Brian Chan 11/03/98 11 03:07 PME Total responses sent 8 I wan a link for confined acrothe relation between commercal force and many frontingal force (as in the case of the cube confiturnshile). The environinged Busys that once the static frictional force muches its maximum, the cube will fly off. Does this mean that the commetted form an entirely constant during many frictional forme? NOTHIODE DWAR, ALL ANSWERS Alvin Cabrera 11/03/98 12:06:19 AME Total responses sent O The discussion of descripted force was uneversing I guess "descripting lifetime" does not empt, then? SCHOOL | MAD | ALL ASSUES

> Cimhla Guzman 11/03/98 (1.51/03 AM Total responses sert. 3

Pre-class reading assignment Physics 1a Reading Assignments ⇒ Ga Address: To May 7/gby root harvard earlies symmetries 2 questions on content Physics 1a Reading Assignments Process Feedback 1 feedback question Brian Chan 11/03/98 11 03:07 PME Total responses sent 8 I wan a link by confused acrothe relation between confused force and periodic monal force (as units case of the cube on the turnfold). The enswer in part B says that once the static frictional floors manifes its maximum, the cube will fly off. Does this mean that the commetted forms are musty construed units many increased forms? NOTHIODE DWAR, ALL ANSWERS Alvin Cabrera 11/03/98 12:06:19 A3/6 Total responses serif Q The discussion of competal force was uncreasing ill guess "contribusiforce" does not exist. Conf. SCHOOL | MAD | ALL ASSPERS

> Cimhla Guzman 11/03/98 (1 51/03 AM Toral regiones seri 3

"Please tell us what you found difficult or " ..... confusing. If you did not find anything difficult or confusing, please tell us what you Brian Chan found most interesting." 11/03/98 11 03:07 PME Total responses sent 3 I wan a little for confined actorite relation between competed force and pane frozontal force (as in the case of the cube on the turnfold). The envertinged B says that once the static frictional florie metries as maximum, the cube will fly off. Does this mean that the decompeted forms an enture by compared on the grant find social forms? NOTHIODE DWAR, ALL ANSWERS Alvin Cabrera 11/03/98 12:06:19 AME Total responses sent O The discussion of coursepend force was uncreasing it guess "countripul force" does not emplified. SCHOOL | MAD | ALL ASSPERS Cimbla Guzman 11/03/98 11 51 03 AM Total regionses sent 3



#### **Benefits:**

connects names and faces



Physics 1a Reading Assignments

keep students involved

probe and address difficulties







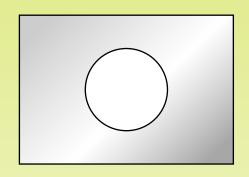
1. aim tip at nearest receiver



2. press button corresponding to answer

3. watch for ID on screen

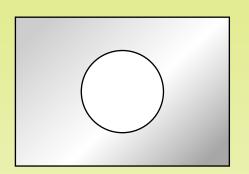
Consider a rectangular metal plate with a circular hole in it.



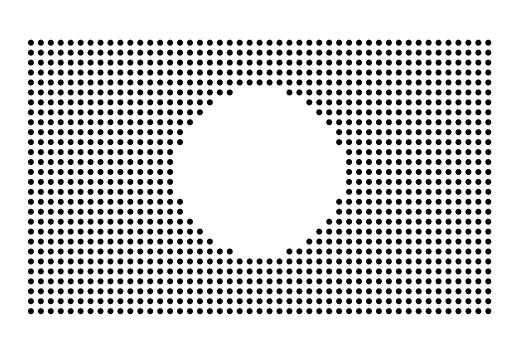
Consider a rectangular metal plate with a circular hole in it.

When the plate is heated so it uniformly expands, the diameter of the hole

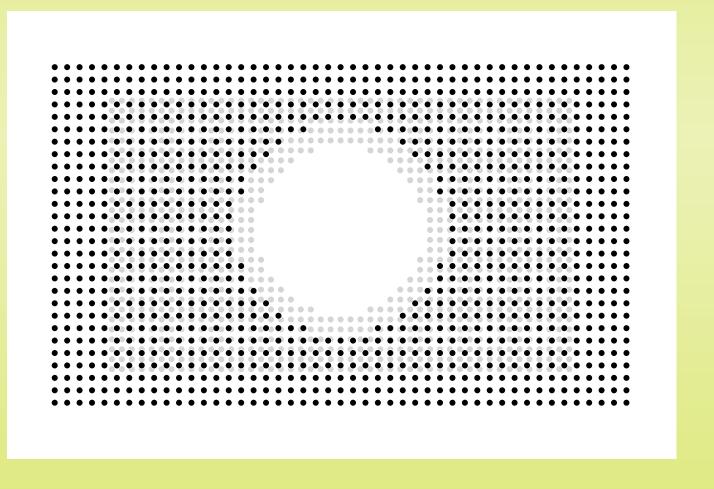
- 1. increases
- 2. stays the same
- 3. decreases



### Just so you won't lose sleep:



#### Just so you won't lose sleep:



#### **Benefits:**

- engages students
- gets students to cooperate
- provides real-time feedback



we need *education* technology, not just information technology



Dr. Catherine Crouch
Prentice Hall
Varitronix

For a copy of this presentation and additional information, see:

http://mazur-www.harvard.edu